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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/896,798	LUO ET AL.	
	Examiner	Art Unit	
	James A. Thompson	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 25 November 2005 and 06 October 2005.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-26 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-26 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 29 June 2001 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5)☐ Notice of Informal Patent Application (PTO-152)
6)☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 06 October 2005 has been entered.

Response to Arguments

2. Applicant's arguments filed 06 October 2005 have been fully considered but they are not persuasive. Applicant's arguments were fully considered and fully addressed in the Advisory Action dated 31 October 2005 and mailed 10 November 2005. The present amendments to the claims have been fully considered and a new search performed for additional prior art and for prior art that better addresses the changed scope of the presently amended claims. Corresponding rejections are given in detail below.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

> Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 12, 16 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025).

Regarding claims 1 and 12: Murayama discloses determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of Murayama); and applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using the M reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama), wherein said determining further comprises assigning all of the pixels of said N level image into M groups corresponding to said M reconstruction levels (figure 4 and column 9, lines 7-18 of Murayama), and calculating each of said M reconstruction levels using the pixels of the respective said group (figure 4 and column 9, lines 34-39 of Murayama).

Murayama does not disclose expressly that said calculating necessarily follows said assigning.

Revankar discloses initially assigning pixels into M reconstruction levels (column 5, lines 6-9 of Revankar) before calculating each of said M reconstruction levels using the pixels of the respective said group (column 6, line 64 to column 7, line 5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught by Revankar, thus

initially assigning the value of the M cluster centers before the step of calculating. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar). Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claims 1 and 12.

Further regarding claim 12: Murayama discloses that the multitone processing method is performed using a computer program (column 14, lines 63-67 of Murayama).

Regarding claim 16: Murayama discloses clustering all of the pixel values (figure 4 of Murayama) of the N level image into M (M<N) reconstruction levels (column 9, lines 34-39 of Murayama) based on the gray level distribution of the N level image (figures 2a-2b and column 9, lines 38-45 of Murayama); and minimizing error between the N level digital image and the M level digital image during said clustering (figure 2b; figure 5 (S23); column 8, lines 44-49; and column 10, lines 22-24 and equation 5 of Murayama). Two methods are used to minimize the error between the N level digital image and the M level digital image during said clustering. The first method is to evenly distribute the threshold values based on the cumulative histogram (figure 2b and column 8, lines 44-49 of Murayama). The second method is to maximize the interclass variance (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama), which also distributes the threshold values as evenly as possible, thus minimizing the error between the N level digital image and the M level digital image during said clustering.

Murayama further discloses applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using said M reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama).

Murayama does not disclose expressly repeatedly revising said clustering of said pixel values into said reconstruction levels until error between the N level digital image and the M level digital image is minimized.

Revankar discloses repeatedly revising the clustering of pixel values into reconstruction levels (figure 6(304,306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 6, line 64 to column 7, line 5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught by Revankar, and thus the clustering taught by Murayama until a predetermined stopping condition is reached, as taught by Revankar, which would be the minimum error taught by Murayama. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar), and it would have been clear to one of ordinary skill in the art at the time of the invention that minimizing error in image document reproduction is desirable. Therefore, it would have been

obvious to combine Revankar with Murayama to obtain the invention as specified in claim 16.

Regarding claim 21: Murayama discloses assigning pixels of the N level digital image to the M cluster centers to provide assigned pixels (column 8, lines 44-49 of Murayama); calculating values of said cluster centers based upon respective said assigned pixel (figure 4 and column 9, lines 34-45 of Murayama); selecting final values of said cluster centers as reconstruction levels (figure 4 and column 9, lines 34-39 of Murayama); and applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image using said reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama).

Murayama does not disclose expressly setting initial values of M cluster centers; and repeating said assigning and said calculating until a predetermined stopping condition is reached and, thereby, final values of said cluster centers are defined.

Revankar discloses setting initial values of M cluster centers (column 5, lines 6-9 of Revankar); and repeating the overall threshold operations (figure 6(304,306) and column 6, lines 56-65 of Revankar) until a predetermined stopping condition is reached (column 7, lines 1-5 of Revankar) and, thereby, final values of said cluster centers are defined (column 7, lines 1-5 of Revankar).

Murayama and Revankar are combinable because they are from the same field of endeavor, namely digital image data threshold determination. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to iteratively perform the threshold determination, as taught by Revankar, thus initially setting the value of the M cluster centers and

repeating said assigning and calculating steps taught by Murayama until a predetermined stopping condition is reached, as taught by Revankar. The motivation for doing so would have been that different portions, or segments, of an image can be better halftoned if multiple thresholds are applied to each region, rather than a single global thresholding (column 2, lines 25-31 of Revankar). Therefore, it would have been obvious to combine Revankar with Murayama to obtain the invention as specified in claim 21.

Regarding claim 22: Murayama discloses that said assigning minimizes respective mean squared error (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama). Maximizing the interclass variance (figure 5(S23) and column 10, lines 22-24 and equation 5 of Murayama), distributes the threshold values as evenly as possible. Since the equation for variance is based on the square of the difference between the respective classes (figure 5(23) and column 10, equation 5 of Murayama), the respective mean squared error is minimized.

Regarding claim 23: Murayama discloses that the stopping condition is a predetermined threshold (column 8, lines 23-29 of Murayama). After the [n-1]th threshold has been determined, the threshold determination is stopped (column 8, lines 23-29 of Murayama).

5. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Merickel (US Patent 4,945,478).

Regarding claim 2: Murayama discloses determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of

Murayama); and applying multilevel dithering (column 14, lines 56-62 of Murayama) to the N level digital image using the M reconstruction levels to produce the M level digital image (figures 8-9 and column 12, lines 58-62 of Murayama).

Murayama does not disclose expressly that said determining step comprises performing a K-means clustering operation on the N level digital image, wherein K=M.

Merickel discloses performing a K-means clustering operation on an N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama and Merickel are combinable because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. Since the pertinent number of levels in Murayama is the M number of levels for the digital image, K would equal M when the teachings of Merickel are combined with the primary teachings of Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama to obtain the invention as specified in claim 2.

6. Claims 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1).

Regarding claim 3: Murayama discloses determining M reconstruction levels (M<N) based on the gray level distribution of the N level image (figure 4 and column 9, lines 34-39 of Murayama); applying multilevel error diffusion (column 14, lines 56-62 of Murayama) to the N level digital image (figures 8-9 and column 12, lines 58-62 of Murayama); and forming a histogram of the N level digital image (figure 2a and column 7, lines 26-31 of Murayama).

Murayama does not disclose expressly locating said M reconstruction levels corresponding to the M most prominent peaks in the histogram.

Ishiguro discloses locating M reconstruction levels (denoted by N in Ishiguro) (column 3, lines 24-25 of Ishiguro) corresponding to the M most prominent peaks in the histogram (figure 7 and column 7, lines 23-26 and lines 59-65 of Ishiguro). A histogram is created (figure 7 and column 7, lines 23-26 of Ishiguro) which set the pixel reference levels based on the number of pixels with densities within a set range (figure 7 and column 7, lines 59-65 of Ishiguro). As can clearly be seen from figure 7 of Ishiguro, this results in the four density levels (S0 to S3) corresponding to the four most prominent peaks in the histogram. This is further evidenced by the language of claim 14 of Ishiguro (column 10, lines 57-60 of Ishiguro).

Murayama and Ishiguro are combinable because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to set the M levels (M<N),

taught by both Murayama and Ishiguro, based on the M most prominent peaks of said histogram, as taught by Ishiguro. The motivation for doing so would have been to prevent degradation of the image quality when error diffusion is performed, which is a common result for predetermined threshold values (column 2, lines 57-65 of Ishiguro). Therefore, it would have been obvious to combine Ishiguro with Murayama to obtain the invention as specified in claim 3.

Regarding claim 13: Murayama does not disclose expressly that the first and last levels of the M levels are predetermined, wherein the first level is zero and the last level is the maximum possible level.

Ishiguro discloses that the first and last levels of the M levels are predetermined, wherein the first level (S0) is zero and the last level (S3) is the maximum possible level (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama and Ishiguro are combinable because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a common feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama to obtain the invention as specified in claim 13.

7. Claims 4-6, 18 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Ishiguro (US Patent 6,501,566 B1).

Regarding claims 4-6 and 18: Murayama in view of Revankar does not disclose expressly that the first and last levels of the M levels are predetermined, wherein the first level is zero and the last level is the maximum possible level.

Ishiguro discloses that the first and last levels of the M levels are predetermined, wherein the first level (S0) is zero and the last level (S3) is the maximum possible level (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama in view of Revankar is combinable with Ishiguro because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a common feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama in view of Revankar to obtain the invention as specified in claims 4-6 and 18.

Regarding claim 24: Murayama in view of Revankar does not disclose expressly that the first and last levels of the M levels are predetermined.

Ishiguro discloses that the first and last levels of the M levels are predetermined (figure 7; column 7, lines 24-26 and column 8, lines 31-34 of Ishiguro).

Murayama in view of Revankar is combinable with Ishiguro because they are from the same field of endeavor, namely digital image binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preset the first level to zero and the last level to the maximum possible level, as taught by Ishiguro. The suggestion for doing so would have been that halftone text data, which has lot of dark pixel surrounded by light pixels, is a common feature in images (column 2, lines 61-63 of Ishiguro). This produces the peaks at the low density end and high density end of the histogram, such as shown in figure 7 of Ishiguro. Thus, the first and last levels should be set to zero and the maximum possible level, respectively. Therefore, it would have been obvious to combine Ishiguro with Murayama in view of Revankar to obtain the invention as specified in claim 24.

8. Claims 7 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Merickel (US Patent 4,945,478), and Eschbach (US Patent 5,565,994).

Regarding claims 7 and 19: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar.

Murayama in view of Revankar and Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed on each of the multiple channels independently.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Revankar and Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform K-means clustering taught by

Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar and Merickel to obtain the invention as specified in claims 7 and 19.

9. Claims 8, 10-11 and 20 rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Merickel (US Patent 4,945,478), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claims 8 and 20: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Merickel discloses performing K-means clustering on a N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. The motivation for doing so would have been that applying a K-means clustering

algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar.

Murayama in view of Revankar and Merickel does not disclose expressly that the N level digital image has multiple channels and K-means clustering and multi-level error diffusion are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Revankar and Merickel is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform the K-means clustering taught by Merickel and the multi-level error diffusion taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama.

Murayama in view of Revankar, Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is specifically multi-level vector error diffusion.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar, Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar, Merickel and Eschbach to obtain the invention as specified in claims 8 and 20.

Regarding claims 10 and 11: Murayama in view of Revankar, Merickel and Eschbach does not disclose expressly that said multi-level error diffusion is vector error diffusion.

Klassen discloses performing vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar, Merickel and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine

Klassen with Murayama in view of Revankar, Merickel and Eschbach to obtain the invention as specified in claims 10 and 11.

10. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Klassen (US Patent 5,621,546).

Regarding claim 9: Murayama in view of Revankar does not disclose expressly that said multi-level error diffusion is vector error diffusion.

Klassen discloses performing vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform vector error diffusion, as taught by Klassen, as said multi-level error diffusion process. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar to obtain the invention as specified in claim 9.

11. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1) and Eschbach (US Patent 5,565,994).

Regarding claim 14: Murayama in view of Ishiguro does not disclose expressly that the N level digital image has multiple

channels and said determining and applying steps are applied to each of said multiple channels independently.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Ishiguro is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform said determining and applying steps, as taught by Murayama in view of Ishiguro, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Ishiguro to obtain the invention as specified in claim 14.

12. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Ishiguro (US Patent 6,501,566 B1), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 15: Murayama in view of Ishiguro does not disclose expressly that the N level digital image has multiple channels and said determining and applying steps are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Ishiguro is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform said determining and applying steps, as taught by Murayama in view of Ishiguro, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Ishiguro.

Murayama in view of Ishiguro and Eschbach does not disclose expressly that said multi-channel image space is specifically multi-channel vector space.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Ishiguro and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process, thus making said multi-channel image space specifically a multi-channel vector space. The motivation for doing so would have been to consider the effects of the

interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Ishiguro and Eschbach to obtain the invention as specified in claim 15.

13. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Merickel (US Patent 4,945,478).

Regarding claim 17: Murayama in view of Revankar does not disclose expressly that said clustering and minimizing steps further comprise performing a K-means clustering operation on the N level digital image, wherein K=M.

Merickel discloses performing a K-means clustering operation on an N level digital image (column 11, lines 26-31 and column 15, lines 9-16 of Merickel).

Murayama in view of Revankar is combinable with Merickel because they are from the same field of endeavor, namely the setting and manipulation of digital image levels to better show the image. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform a K-means clustering operation, as taught by Merickel, on the N level digital image taught by Murayama. Since the pertinent number of levels in Murayama is the M number of levels for the digital image, K would equal M when the teachings of Merickel are combined with the primary teachings of Murayama. The motivation for doing so would have been that applying a K-means clustering algorithm would optimize the cluster assignments for the pixels since, upon completion of the iterations, less than

one percent of the pixels change cluster assignments (column 11, lines 50-55 of Merickel). Therefore, it would have been obvious to combine Merickel with Murayama in view of Revankar to obtain the invention as specified in claim 17.

14. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025) and Eschbach (US Patent 5,565,994).

Regarding claim 25: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and said setting, assigning, calculating, repeating, selecting and applying steps are performed independently on each of said multiple channels.

Eschbach discloses an N level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach), wherein said multiple channels are processed independently (column 4, lines 23-25 of Eschbach).

Murayama in view of Revankar is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data, as taught by Eschbach, upon which to perform said setting, assigning, calculating, repeating, selecting and applying steps, as taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach).

Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar to obtain the invention as specified in claim 25.

15. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama (US Patent 5,936,684) in view of Revankar (US Patent 5,649,025), Eschbach (US Patent 5,565,994), and Klassen (US Patent 5,621,546).

Regarding claim 26: Murayama in view of Revankar does not disclose expressly that the N level digital image has multiple channels and said setting, assigning, calculating, repeating, selecting and applying steps are performed in multi-channel vector space.

Eschbach discloses an N-level digital image (column 4, lines 18-20 of Eschbach) which has multiple channels (column 4, lines 21-24 of Eschbach).

Murayama in view of Revankar is combinable with Eschbach because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple channel image data space, as taught by Eschbach, upon which to perform said setting, assigning, calculating, repeating, selecting and applying steps, as taught by Murayama, with each channel being processed independently, as taught by Eschbach. The motivation for doing so would have been that independent (column 1, lines 32-35 of Eschbach), separated primary color channels are necessary for the production of digital color images (column 1, lines 24-31 of Eschbach). Therefore, it would have been obvious to combine Eschbach with Murayama in view of Revankar.

Murayama in view of Revankar and Eschbach does not disclose expressly that said multi-channel image space is specifically multi-channel vector space.

Klassen discloses performing multi-level vector error diffusion (column 4, line 66 to column 5, line 3 of Klassen).

Murayama in view of Revankar and Eschbach is combinable with Klassen because they are from the same field of endeavor, namely digital image data halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically perform multi-level vector error diffusion, as taught by Klassen, as said multi-level error diffusion process, thus making said multi-channel image space specifically a multi-channel vector space. The motivation for doing so would have been to consider the effects of the interactions between dot patterns of different color components (column 3, lines 21-27 of Klassen). Therefore, it would have been obvious to combine Klassen with Murayama in view of Revankar and Eschbach to obtain the invention as specified in claim 26.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

James A. Thompson
Examiner
Art Unit 2624

01 February 2006